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DRIVE AND BRAKE

Description:

The present invention relates to a drive and brake.

From DE 36 13 294, an electromagnetically actuable brake for a motor is known. The brake is operated by a unipolar voltage. Such DC voltage brakes are used in particular with drives that include electromotors.

From DE 101 46 896 A1, a drive system is known that includes a brake and an electromotor, which is supplied with the aid of an output stage.

From U.S. 4,090,117 A, a single-phase capacitor motor having a brake is known; the coil of the brake configured as power-off brake is excited by an alternating current, which is taken directly from the supply lines of the motor.

Converters include at least one output stage and control electronics, which operate according to a pulse-width modulation method.

The present invention is therefore based on the objective of increasing the safety in industrial drives.

According to the present invention, the object is achieved in the drive according to the features indicated in Claim 1.

Essential features of the present invention in the drive are that the drive includes at least a brake and an electromotor, which is connected to an output stage with the aid of supply lines;

the brake being supplied from a brake control;

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for its supply, the brake control is connected to the supply lines with the aid of capacitors.

It is advantageous in this context that the supply of the brake control is a function of the AC voltages of the supply lines. As a result, the method of functioning of the output stage, i.e., in particular also the method of functioning of a rectifier, inverter or power converter including the output stage, is advantageously able to be linked to the method of functioning of the brake. In particular, this makes it possible to realize a safety brake which causes the brake to be activated in the event of faults in the output stage or in the mentioned devices.

As a result, the drive is advantageously able to be braked should a fault occur. This also applies, in particular, to a voltage failure such as a power failure, for example. One skilled in the art is able to dimension the capacitors and the brake control as well as the brake in a manner that is appropriate for a response to the occurrence of the mentioned faults and additional faults.

The drive according to the present invention thus includes at least a brake and an electromotor, which is fed by an alternating current by an output stage via supply lines, the brake being supplied from a brake control which, via at least one capacitor, is connected to at least one of the supply lines and supplied therefrom.

In an advantageous embodiment, the output stage is able to be operated in a pulse-width modulated manner. It is advantageous in this context that the motor is not only able to be supplied but also controlled, and may even be regulated if feedback of sensor signals or other electro-technical variables takes place.

In an advantageous development, the brake is activated in response to long-lasting occurrences of DC voltages or zero voltages on the supply lines, i.e., brake torque is transmitted to the rotor shaft of the motor or to a shaft connected to the rotor shaft. In particular, the brake is activated, i.e., transmits brake torque to the rotor shaft of the motor or to a shaft connected to the rotor shaft, if a critical minimum frequency of the respective time characteristics of the potentials of the supply lines is undershot. It is advantageous in this context that high reliability acting according to physical laws is achievable. For, when the brake control is not supplied, the current flowing through the solenoid of the brake drops, and a spring force acting counter to the magnetic force is able to press a brake lining against a brake surface.

Instead of undershooting of a frequency, the brake is activated also when critical RMS values of the potentials of the supply lines are undershot, i.e., brake torque is transmitted to the rotor shaft of the motor or to a shaft connected to the rotor shaft. It is advantageous in this context that reliable deactivation is provided in the event of this type of fault as well.

In an advantageous development, the brake also includes a brake coil having a one-part or two-part design. It is advantageous that a cost-effective brake is able to be provided with the one-piece design, and that it is possible to provide a brake coil which is able to be activated very rapidly in the case of the two-part brake coil. To this end, a brake control is to be developed which acts according to that in DE 36 13 294, but is supplied from the supply lines with the aid of capacitors.

Essential features of the brake according to the present invention are that it is actuable electromagnetically, brake for an electromotor, which is connected to an end stage, in

particular of a converter, an inverter or a similar converter, via supply lines,

the brake being supplied from a brake control, the brake control being connected to the supply lines for its supply, via at least one capacitor.

An advantage of the brake is that it is an electromagnetically actuable brake and the actuation therefore requires an electrical supply. When this supply fails, the brake is activated and the mechanically coupled electromotor is braked or stopped. The brake can be released only when an electrical supply is available. This increases the safety of the drive in emergencies or in the case of faults such as a power failure or the like.

Further advantages are derived from the dependent claims.

List of Reference Numerals

1 output stage, three-phased

2 motor

3 brake

4 brake control

C1 capacitor

C2 capacitor

C3 capacitor

The present invention will now be explained in detail with the aid of figures:

Figure 1 shows a drive according to the present invention. It includes at least one output stage 1 of a converter, a brake 3 having an associated brake control 4, and a motor 2 on whose shaft -- in particular rotor shaft or on a shaft connected thereto -- the brake transmits brake torque when it has been activated, i.e., has not been disengaged. The output stage is triggered by control electronics supplied with a 24 V DC voltage.

The converter has an intermediate direct current link from which the switches of output stage 1 are supplied. The switches of the output stage are triggered using pulse-width modulation methods, in such a way that the motor is supplied with a three-phase pulse-width modulated voltage. To this end, the converter at all times supplies at the output of its output stage a three-phase voltage indicator value, i.e., three output potential values that are applied at the three supply lines to the motor. To generate the values, the switches of the output stage establish a brief connection of different lengths to the different potentials of the so-called intermediate direct current link supplying the output stage, for each pulse-width modulation period, connected or separately. The desired potential value is generated as time average across a pulse-width modulation period.

The output stage is embodied with safe deactivation. The safety is designed in such a way that it is no longer possible to generate a rotating field once the control electronics of the converter have been turned off, so that no rotation of the rotor, acting from the direction of the converter, is able to be forced. In this way the output stage and the power stage are able to be deactivated in a safe manner. The safe switch-off according to the present invention is also implementable according to DE 102 06 107 A1 or according to

DE 102 07 834 A1. The safe deactivation of the output stage prevents the formation of a field of rotation. However, this also means that the brake control is without supply.

Brake control 4 includes at least one rectifier, which is supplied in a capacitive manner from the supply lines for the motor with the aid of capacitors C1, C2, C3. The unipolar voltage generated by the rectifier is able to supply the brake. The brake has a two-part design as in DE 36 13 294.

If the control electronics of the converter or its voltage supply fails, or if a corresponding failure or damage occurs, the supply of the electromotor will not function correctly. In particular, three permanent DC voltages or even zero voltages are applied at the motor. This has the result that the supply of the brake control is interrupted since no energy is then transmitted via the capacitive coupling in the case of DC voltages. The solenoid coils of the brake then become currentless, and the brake is activated as a result. This application is effected by the force of spring elements since the previously counteracting force of the energized solenoids is lacking.

In this way a safety brake is produced, which is activated automatically and in a physically completely safe manner, and which generates brake torque as soon as the converter no longer works correctly. In fault-free functioning, AC voltages are at all times applied at the three supply lines between output stage and motor, which have a frequency in the range of more than 1 kHz, in particular 4 kHz or 8 kHz or 16 kHz. In further exemplary embodiments according to the present invention, it is also possible to provide frequency ranges, in particular around the mentioned frequencies. Care must be taken that these AC voltages are also applied when the motor is a synchronous motor and is regulated to a standstill by the converter. For even then the three potential or voltages values of the three lines are generated by pulse-

width modulation. The potential or voltage value is always the average across a pulse-width modulation period.

The illustrated DC voltages and zero voltages do not only occur in the described fault cases but also during normal operation when a regular shut-down of the motor is required, for instance also during shut-down of the converter.

In other exemplary embodiments of the present invention, the brake has also only one part, in which case only two lines lead from brake control 4 to brake 3.

In further exemplary embodiments according to the present invention, the motor is to be supplied not in a three-phase, but in a two-phase manner. Accordingly fewer capacitors are required to supply brake control 4.

In additional exemplary embodiments of the present invention, a reluctance motor, an asynchronous motor or a synchronous motor are provided as electromotor.

In another exemplary embodiment of the present invention according to Figure 2, it is also possible to provide only one capacitor C1 instead of the three capacitors C1, C2, C3. This makes it possible to use fewer parts and to reduce the cost.

The present invention is applicable in analogous manner to power converters as well.